

REMARKS

Claims 1 and 2 are currently pending. Claim 1 is amended, and none of the amendments constitute new matter. Claim 2 is canceled. The Examiner has rejected claim 1 under 35 U.S.C. § 102(b) as being anticipated by Yoshimoto et al. The Examiner has rejected claim 2 under 35 U.S.C. § 103(a) as being unpatentable over Yoshimoto et al. in further view of Higuchi et al. The Examiner's rejection of claim 2 is rendered moot in light of Applicants' cancellation of claim 2.

The present invention is directed to a hydrostatic gas bearing of an orifice type possessing a single restriction mechanism for the creation of a squeezing effect based on adiabatic expansion. This effect creates a gaseous film that prevents direct contact between a guide and a slider of a moving stage in various precision machine tools. The present invention further relates to a gas injection port whereby air is provided to the guide, and an air groove that is formed in the surface of the bearing in order to enhance its stiffness. In particular, the present invention claims a particular clearance of the gas bearing of at most 3 μm and a ratio of the depth of the air groove to the bearing clearance of at least 5. In addition, the gas bearing of the present invention comprises silicon nitride and/or Sialon as its main component. In order to realize the effect of the gas bearing of the present invention, ceramics with low coefficients of thermal expansion are required, as the bearing clearance may otherwise undergo significant changes upon thermal fluctuations during working.

The Examiner alleges that claim 1 is anticipated by Yoshimoto et al., which teaches a hydrostatic bearing with self-controlled restricting mechanism. However, Yoshimoto et al. aims to "improve the stiffness of the hydrostatic bearing" by minimizing the bearing

clearance (column 1, lines 19-21). Yoshimoto et al. acknowledges that a low damping characteristic is associated with the hydrostatic bearing mechanism, but only aims to address the low stiffness conventionally associated with hydrostatic bearings. The reference does not disclose the method for improving damping of the present invention. Applicants state that “it is one of the objects of the present invention to provide a hydrostatic gas bearing having particular damping characteristics” (paragraph 0006). The Yoshimoto et al. reference does not teach preferred bearing clearance specifications addressing conventional low damping characteristics. As such, the Yoshimoto et al. patent does not anticipate claim 1.

Furthermore, the bearing described by Yoshimoto et al. is structurally different from the claimed invention. The hydrostatic bearing disclosed in Yoshimoto et al. uses a self-controlled restricting mechanism, which relates to a variable restricting mechanism. As shown in Figure 1 of Yoshimoto et al., orifices are provided both at the air-supply side and on the bearing surface. The through-holes (25a and 26a) provided on the bearing surface are the first orifice, and a through-hole (36) provided at the opposite side of the bearing surface is the second orifice. Thus, the self-controlled restricting mechanism in Yoshimoto is required with a two-step restriction. Meanwhile, as shown in Figs.1 and 2, the present invention uses a single restriction mechanism utilizing a cross-T shape design to obtain a high damping ratio. As such, the present invention represents a significant simplification of and improvement upon the mechanism disclosed in the prior art and is not anticipated by Yoshimoto et al.

Finally, Yoshimoto et al. fails to teach or suggest the bearing clearance of the claimed invention. As stated in paragraph 0023 of the specification, the damping ratio can significantly change depending upon the depth of the air groove. When a bearing clearance (h)

is 5-7 μm , which is typically used in the art, the groove depth increases. In such case, an increase of the groove depth does not necessarily result in an increase in the damping ratio. For example, the damping ratio *decreases* as the groove depth increases when bearing clearance is 5 or 7 μm (see Figures 4 and 5 respectively). However, these tendencies greatly change when the bearing clearance is maintained at 3 μm or less as claimed in the present invention. When the bearing clearance is held to 3 μm or less, the damping ratio *increases* as the groove depth increases (see Figure 3). Yoshimoto et al. does not teach or suggest the effects of the bearing clearance being maintained at 3 μm or less. Therefore, claim 1 is not anticipated by or obvious over Yoshimoto et al.

The Examiner alleges that claim 2 is unpatentable over Yoshimoto et al. in view of Higuchi et al. Higuchi et al. discloses a slide apparatus and its stage mechanism for use in a vacuum. While Higuchi et al. teaches the use of ceramics with low coefficients of thermal expansion for use in the stage base plate of the apparatus in one particular embodiment (column 24, lines 64-67), the reference does not teach the use of such ceramics as material for the slide shaft, air slide bearing, etc. For these elements, ceramics that are “high in rigidity, light in weight and non-magnetic” are used (column 13, lines 57-64). Higuchi et al. uses the compounds of alumina and silicone carbide as examples. In the present invention, ceramics with a lower coefficient of thermal expansion, namely silicon nitride and Sialon, are used as the main components of the air slide in order to maintain the requisite structural requirement of the present invention regardless of temperature changes. The coefficient of thermal expansion of silicon nitride and of Sialon at room temperature is 1.2 ppm/K, which represents 1/4 that of alumina and 1/2 that of silicon carbide. Furthermore, neither silicon nitride nor Sialon are

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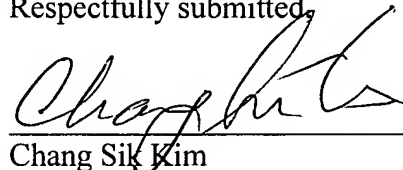
mentioned in the Higuchi reference, as they have not previously been realized for use in gas bearing components. As such, due to the differences in quality of the ceramics proposed by Higuchi et al. and Applicants, Higuchi et al. cannot be said to obviate the present invention. Furthermore, because Yoshimoto et al. does not teach each and every element of pending claim 1, claim 1 is not obvious over Yoshimoto et al in view of Higuchi.

Applicants respectfully seek allowance of claim 1 as amended herein. Applicants believe that no fee is due at this time. However, the Commissioner is hereby authorized to charge payment of any unanticipated fee or credit any overpayment to Deposit Account No. 02-4377.

Respectfully submitted,

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